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To: Dr. Donald Leyden

Date: February 4, 1992

From: R. W. Dwyer

Subject: Current Operational Plan for Project Tomorrow

OBJECTIVE

Our goals are to evaluate the feasibility of developing ignition-propensity tests for cigarettes and to evaluate the technical and commercial feasibility of making cigarettes with reduced ignition propensities with respect to such a test.

BACKGROUND

On August 10, 1990, the Fire Safe Cigarette Act was signed into law. This law empowers the Consumer Product Safety Commission to direct the National Institute of Standards and Technology to evaluate the feasibility of developing a standard method for determining cigarette ignition propensities, to compile performance data for cigarettes using this standard method, and to conduct laboratory studies on and computer modeling of ignition physics.

The challenge is to determine if there are any reliable tests for assessing cigarette ignition propensity. If so, we then need to evaluate our ability to manufacture and sell products which show improved performance with respect to an as yet undefined test.

Manufacturing cigarettes designed to comply with this undefined test could have a major impact on our products. It is possible that we may need to: 1) alter the way we process tobacco; 2) increase significantly the amount of expanded material in our blends; 3) reduce the lengths and/or circumferences of cigarettes; 4) procure, or modify in-house, novel cigarette wrappers. Each of these modifications could require fairly drastic changes in the production of cigarettes.

STRATEGIES

- **1 Evaluate the feasibility of developing tests for cigarette ignition propensities and determine the extent to which cigarette design parameters influence their performance with respect to such tests.**

STATUS: We have examined a variety of fabrics and fabric treatments in an attempt to develop a reliably ignitable substrate. Additionally, we have gone to great lengths to control the temperature, relative humidity, and draft rate in the environment of the test. Unfortunately, we still get significant variation

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in results. Currently, we are trying to minimize variability in the materials and conditions of the tests and perform many more replicates in order to achieve reproducibility.

- **2 Evaluate the mechanism of cigarette-induced fabric ignitions and develop a computer model of a smoldering cigarette interacting with a substrate.**

  STATUS: At this time, we have working models of both a smoldering cigarette and a substrate exposed to a specified heat flux. Both of these models are being calibrated with experimental results on the thermal properties of cigarettes smoldering freely and on substrates.

- **3 Determine the effects of banded wrappers on ignition testing.**

  STATUS: Given the situation of an undefined ignition test, we are examining the influence of band widths and densities on cigarette mass burn rates and extinguishments.

- **4 Design cigarettes at reduced mass burn rates which maintain consumer-acceptable delivery, physical, and subjective properties.**

  STATUS: We have been able to reduce the mass burn rates of cigarettes to 40 mg/min. However, this burn rate reduction causes an increase in puff count and a decrease in subjective acceptability. Currently, we are examining lower-density blends in these cigarettes.

TACTICS AND TIMETABLE

Strategy 1. Test Development

1. Develop a protocol for testing sixteen cigarettes simultaneously; test protocol repetitively to determine the number of tests required for statistical validity. (1Q92)

2. Re-make and re-evaluate the ignition propensities of the TSG cigarette series. (2Q92)

3. Experimentally determine the effects of cigarette design parameters on ignition propensities; design parameters include wrapper variables, rod density and circumference, tobacco shred width, and cigarette pressure drop. (4Q92)

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4. Evaluate the preliminary testing protocols of NIST. (4Q92)

5. Evaluate the technical feasibility of producing cigarettes with lower ignition-propensities with respect to the NIST test. (1993)

6. Implement the NIST ignition-propensity test and examine for correlations with our in-house tests. (1993)

7. Determine the effects of cigarette thermal properties on the NIST test, and develop a secondary test, if possible. (1993)

Strategy 2. Mechanisms and Modeling

1. Develop a computer model of smoldering cigarettes which accounts for the effects of cigarette design parameters on cigarette heat flux, coal length, and burn rate; correlate predictions with experimental results. (2Q92)

2. Develop a computer model of the temperature and oxygen distributions at the surface of fabric/foam substrates; correlate predictions with experimental results. (2Q92)

3. Determine the temperature fluctuations of cigarette coals and fabrics during ignition testing. (2Q92)

4. Experimentally determine the influence of draft rate on cigarette heat flux. (3Q92)

5. Develop a computer model which predicts the probability of ignition of a smoldering cigarette on a fabric/foam substrate. (4Q92)

4. Exploit the model to determine the influences of cigarette design parameters on ignition propensities. (1993)

5. Use IR, Schlieren, X-ray, and neutron imaging to examine the cigarette and substrate structure during smoldering. (4Q92)

6. Obtain and evaluate the NIST computer model of cigarette ignition propensities. (1993)

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Strategy 3. Banded Wrappers

1. Evaluate the bobbins of strip-applied wrapper submitted by Molins. (2Q92)

2. Evaluate samples of Avicel-banded wrappers from KC. (2Q92)

3. Evaluate strip-applied wrappers from our in-house unit. (2Q92)

4. Evaluate other in-house methods which have been developed to apply bands to wrappers (on-going)

5. Re-design wrappers to meet our in-house ignition tests; obtain samples for further testing. (4Q92)

6. Design cigarettes with banded wrappers which have reduced ignition propensities with respect to the NIST method when it is developed. (1993)

7. Investigate other technologies for improving cigarette fire-safety as we become aware of them. (On-going)

Strategy 4. Cigarette Design

1. Develop low-density tobacco blends, utilizing DIET and NET tobaccos and small lamina, for selected brands in order to reduce their puff counts. (4Q92)

2. Fabricate, CTSD test, and subjectively evaluate low-MBR products; optimize subjectives through re-design where necessary. (4Q92)

3. Design, fabricate, and evaluate low-IP versions of all PM cigarettes. (1994)

4. Evaluate commercial feasibility of manufacturing and selling cigarettes which demonstrate reduced ignition propensity with respect to the NIST IP test. (1995)

1992 RESOURCES

1) Physical Research	8.5
2) Product Development	5.0
3) Flavor Development	2.0
4) Tobacco Processing & Fabrication	1.5
5) Cigarette Testing Services	1.5
6) Leaf Department	1.0
7) Analytical	0.5
8) Engineering	0.5
TOTAL	20.5

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